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## A case of web-based collaborative inquiry-learning using OpenLearn technologies

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We describe and discuss the implementation of “WOPP in Cyberculture”, an elective discipline of the Erasmus Mundus’ European Master Program on Work, Organization and Personnel Psychology (WOPP), offered by the Faculty of Psychology, University of Coimbra, in 2008. We adopted a web-based collaborative inquiry-learning model supported by UK Open University’s OpenLearn technologies: a community-led virtual learning environment based on *Moodle* called *LabSpace*, and a knowledge mapping software called *Compendium*. Rubrics were used to assess students’ maps and presentations. To assess students’ satisfaction and opinion, at the end of the course we applied an evaluation questionnaire. Results indicate that the implementation of the web-based inquiry-learning model we have proposed was relatively successful and adequate to the learning setting. Rubrics’ scores point to an overall improvement of students’ maps and presentations. Reports on students’ satisfaction with different aspects of the course were positive. Nevertheless, further investigation on the validity and reliability of the rubrics is required.

**Keywords** web-based collaborative learning; inquiry learning; concept maps; hypermedia maps; open source education; OpenLearn; LabSpace; Compendium

### 1. Introduction

Inquiry learning is a pedagogical strategy aimed at promoting student exploration of knowledge, problem solving, critical thinking and understanding of scientific concepts. Although, different definitions and models have been proposed, some authors suggest that the inquiry process should include six fundamental steps: 1 - familiarising with the subject or problem; 2 - generating questions and hypothesis; 3- exploring knowledge and collecting data; 4- interpreting and/or explaining data; 5- revising and drawing conclusions; 6 - reporting [1].

Questioning is the drive of inquiry learning. Students ask relevant questions, search for answers and generate explanations based on readings and information resources either provided by the teacher or selected by the students. Divergent thinking should be encouraged and nurtured so that the students realize that knowledge is not close or static, and that questions can have more than one “good” or correct answer. It also can lead to additional questioning and alternative hypothesis generation [2]. Although there may be individual tasks, students benefit more from an intensive interaction and discussion both with the teacher and with their peers. When students work into groups and intensively collaborate during this process, we call it *collaborative inquiry learning*.

The dissemination of personal computers and Internet technologies in recent years has fostered the development of technology enhanced inquiry-based learning models. For example, Chang, Sung and Lee [1] proposed a web-based collaborative inquiry-learning model where students used: the web as information source; concept mapping software as a tool for anchoring and representing knowledge during the inquiry process; notepads to help compile, edit and share information; and chat sessions for synchronous group discussions. Abdelraheem and Asan [3] used concept-mapping software, web search, and MS PowerPoint as tools for students to create their maps and class presentations. In order to assess students’ learning experiences, these authors employed pre-post assessments, rubrics and informal interviews to evaluate students’ concept maps, presentations, and self-reflective reports. These two studies pointed out the benefits of integrating collaboration, inquiry, and concept mapping as pedagogical strategies supported by appropriate technologies. Abdelraheem and Asan support that computer supported collaborative environments has a positive effect on students learning experiences, and that inquiry based learning activities allow students to be self-regulated and independent learners, and stimulate deeper-level cognitive strategies such as monitoring, creating representations, reflecting, and sharing information (p.78-79). Chang, Sung and Lee point to the benefits of using the web as a knowledge base, and of using concept maps to help students organize their ideas, plan hypotheses, represent, and communicate their knowledge. But, for this strategy to be more effective, they stressed the need of proposing authentic tasks, an intensive students’ training in the use of concept maps, more freedom for them to use the proper combination of strategies such as collaborative learning, inquiry learning and concept mapping in an on-demand manner, and a better method of creating a and preserving the uniqueness of each group’s products (p.67).

Our aim here is to describe and discuss the implementation of a web-based collaborative inquiry learning model built upon the two studies mentioned above, using OpenLearn technologies [4] as support: a community-led virtual learning environment (VLE) based on Moodle called *LabSpace*, and a knowledge mapping software called *Compendium*.

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## 2. Background

*Learning setting.* Our model was tailored to fit the needs of “WOPP in Cyberculture”, an elective course of Erasmus Mundus’ European Master Program on Work, Organization and Personnel Psychology (WOPP), offered by the Faculty of Psychology, University of Coimbra, in 2008. The course aimed at creatively exploring and critically discussing the influence of ICT in the world of work and of organizations, the psychosocial aspects of working in virtual environments, and its implications to the field of WOPP. The course was divided in four units: 1 – Reflections on the concepts of postmodern, post-industrial, and information society; 2 – Cyberculture; 3 – Cyberpsychology (Internet Psychology); 4 – Information and Communication Technologies (ICT) in WOPP. There was also an introductory unit to familiarize students with course objectives, methodology, and technologies used. The primary course delivery method was in-class, face-to-face (10 sessions of three hours each), but we planned about 40 to 60 hours for off-class individual study and group work supported by a VLE.

*Participants.* 24 master students (6M, 18F), from different nationalities, ranging between 21 to 35 years old.

*Learning environment and tools.* OpenLearn is an open educational resource website launched by The Open University (UK). It offers free learning materials, learning tools and community-led environments to enable collaboration on the research and development of open educational resources [4]. One of the areas of OpenLearn is *LabSpace*, a VLE based on *Moodle*<sup>ii</sup>, which serves as host for collaborative activities, projects, and professional communities aimed at research, development, and use of open educational resources. We used *LabSpace* as a course material repository (syllabus, schedules, news, PowerPoint presentations, articles, assessment tools etc.); as a place for students to share their maps and other documents; and as a host for online group discussion forums. For creating hypermedia maps, we used *Compendium*, one of the tools provided by *LabSpace*<sup>iii</sup>.

*Learning model.* Each course unit consisted of a six-step cycle and took about two weeks to complete. The steps are:

1. **In-class lecture.** The teacher introduces the topics of the current unit. Class is divided into groups. Each group chooses one topic among those suggested by the teacher, and the teacher indicates the readings for the topic chosen, except for the last unit, when students have more freedom to search and select the readings.
2. **Individual study and questorming**<sup>iv</sup>. Based on the readings students formulate questions and hypotheses about their topic. The groups can also break their topic into sub-topics and assign them freely to each member. Although not compulsory, students are requested to post their questions and hypotheses in *LabSpace* group discussion forums.
3. **Selection of preferred questions and hypotheses.** Each group discusses and selects the questions and hypotheses they find most relevant or interesting. They can use *LabSpace* forums in order to do this task.
4. **Web search.** The students search the Internet for websites, articles, images, audios, videos, etc. and select the pieces of information that they find relevant in order to answer the assigned questions/hypotheses.
5. **Collaborative map construction.** Using *Compendium*, students build collaboratively a hypermedia map, attaching the information they have selected, as well as their own questions, hypotheses, comments, and reflections, in a coherent structure. Students are free to choose how many pieces and which kind of information (concepts, texts, images, videos etc.) they want to include in their map, how they will build the relationships, and label them. Here, they also can use *LabSpace* group discussion forums to share their map parts with other group members.
6. **In-class group presentations and class discussion.** Each group presents their topic to the class using their map as support. Teacher comments on the maps and presentations, and moderates classroom discussions.

For evaluation and research purposes, it would be preferable that all interaction and exchange of documents among the students occurred inside *LabSpace*, in order to be recorded. However, as it was a real-life situation, we knew that students would meet face-to-face outside class (in the library, the cafeteria, the computers lab etc.). We also knew that many would bring their laptops to the university, so that they could work together without the need of a VLE for mediation. We also let them free to distribute and coordinate their own work, and in the creation of their maps. Concept mapping has been considered a powerful problem-solving technique, particularly in ill-structured situations [5]. The freedom for map construction intended to foster student’s exploration and creative representation of the ill-defined, open-ended, and ill-structured subject domains approached in our course. In terms of Ruiz-Primo framework for mapping assessment, this task was totally low-directed [6]. Therefore, groups could create different types of hypermedia-enriched maps, such as concept, mind, semantic maps etc., or a mix of them.

*Assessment tools.* To assess students’ profiles and learning experiences we employed four instruments:

<sup>ii</sup> See: <http://moodle.com/>

<sup>iii</sup> For a more detailed description of *LabSpace* and *Compendium* see respectively: <http://labspace.open.ac.uk/> and <http://openlearn.open.ac.uk/course/view.php?name=KM>.

<sup>iv</sup> Questorming is a brainstorming session aimed at formulating multiple questions about a chosen topic. Preferably, not superficial or easy-to-answer questions, but creative and investigative ones.

1. **Profile questionnaire.** A 20 item online questionnaire (close answers) concerning students' age; nationality; gender; experience in using computers, Internet, and VLEs; familiarity with mapping techniques and mapping software; familiarity with the topics covered by the course and perceptions of their relevance to students' own career; and learning preferences. The questionnaire was applied at the beginning of the course.
2. **Rubric for collaborative maps.** A rubric for assessing students' maps, which considered six aspects: 1 - quality of map description; 2 - quality of generative questions; 3 - content relevance, coverage, and depth; 4 - quality of map structure and organization; 5 - quality of hypermedia; and 6 - quality of students' comments. Each of these items was scored based on a 5-point likert-type scale, after a qualitative appreciation of the map by the teacher.
3. **Rubric for group presentations.** Here, three aspects were considered: 1- clarity of the exposition; 2- participation of all group members; and 3- interaction with the class. Each of these items had a score attributed by the teacher after the group presentation based on a 5-point likert-type scale. This and the previous rubric were available to the students at the beginning of the course, in order to serve not only as assessment instruments, but also as a checklist to help the students build the maps and plan their presentations. Both rubrics also had a place for written comments made by the teacher.
4. **Course evaluation questionnaire.** An online 4-point likert-type scale of 28 items to assess students' satisfaction and opinion about different aspects of the course, such as: adequacy of students' prerequisite knowledge; relevance of course contents; quality of teacher presentations; students' interest and active participation; quality of course materials; contribution of questormings, group discussions and collaboration, map building, and other groups' presentations to the learning process; contributions of technologies used to the learning process; adequacy of timetable, difficulty level and of evaluation methods; personal level of engagement and motivation during the course. This form was available at the end, after the final grades were divulged. Answering it was optional and respondents were anonymous.

### 3. Implementation: findings and discussion

Of the total class, 20 (83%) students answered the profile questionnaire. More than 80% of these students had experience using computers for more than 5 years, had their own computer with Internet connection at home, and used them in a regular basis (>10 hours per week). However, about 60% were little or not familiar with VLEs, and more than 90% was little or not familiar with knowledge mapping software. More than 90% found the topic ("ICT in WOPP") relevant or highly relevant to their professional training, although 95% had little or no familiarity with the concepts and theories of cyberculture and of cyberpsychology. Therefore, most students perceive the main subject of the course as a novelty with high relevance to them.

Because most of them were not familiar with VLEs and with mapping techniques and software, the introductory unit played an important role in offering an "intensive students' training" opportunity (as previously suggested by Chang, Sung and Lee [1]). In the computers lab, after a brief explanation on the main functionalities of *LabSpace*, students had the opportunity to explore the learning environment, create their profiles, post welcome messages in the discussion forum, and download the course materials. After this session, they had an explanation on different types of maps and mapping techniques, and a practical session with *Compendium*, where they had to create a hypermedia map of their professional interests, export and upload it to *LabSpace*. As this training might not be sufficient, we also created a discussion forum for answering questions mainly about methodological and technological issues.

Due to changes in schedule demands, the whole course had to be shrunk from 8 to 4 weeks. This meant that we had to cover one unit per week. To gain more time, we changed the strategy of the first unit into a lecture followed by readings and some discussion in *LabSpace*'s forum. Students also used the online forum for forming the groups. Course units 2, 3 and 4 followed the steps of the learning model described in the previous section.

Because it was not mandatory and most students could meet face-to-face during the week, few groups used the discussion forums to post their questions and hypothesis. Most of the students used the forums mainly to plan their face-to-face meetings and exchange parts of maps they have made. The excerpt below is a good example of all this uses coming from one of the groups:

**Juliana - Monday, 24 March 2008, 14:25**

Hello Group!!! i'm reading the Lévy text (chapters VIII - IX) and i'm searching on internet... when i've more information, i'll start the mental map, and i'll send it to you, and then we can discuss how to complete it, with the info you have read... sounds goog for you? let me know!!! Bye

**Juliana - Monday, 24 March 2008, 22:20 - Document attached: questorming.doc**

hey people!!! for the first part of the map, the questorming, i'm thinking in this questions (in the attach document)... let me know what do you think!!! bye

**Ivan - Tuesday, 25 March 2008, 10:04**

Hy Juliana!! The questorming for me it's good! One question, you have all the chapters of Lévy text? Beijós

**Juliana - Tuesday, 25 March 2008, 16:33**

yes... i've read the two chapters of Lévy text... and i'll send more questions about it... and then, we can start the map. bye

**Ivan - Tuesday, 25 March 2008, 17:45**

Juliana, have you read the email of the professor? We could prepare the map tomorrow together and show it on thursday...let me know what do you think...

**Juliana - Tuesday, 25 March 2008, 18:33 - Document attached: art\_and\_cyberculture.xml**

yep... i read it... for my is ok, if all the group wants, so we have to ask the girls about it... I'm sending the first version of the map... but there's still a lot of work!!!! let me know what do you think

**Ivan - Tuesday, 25 March 2008, 19:36**

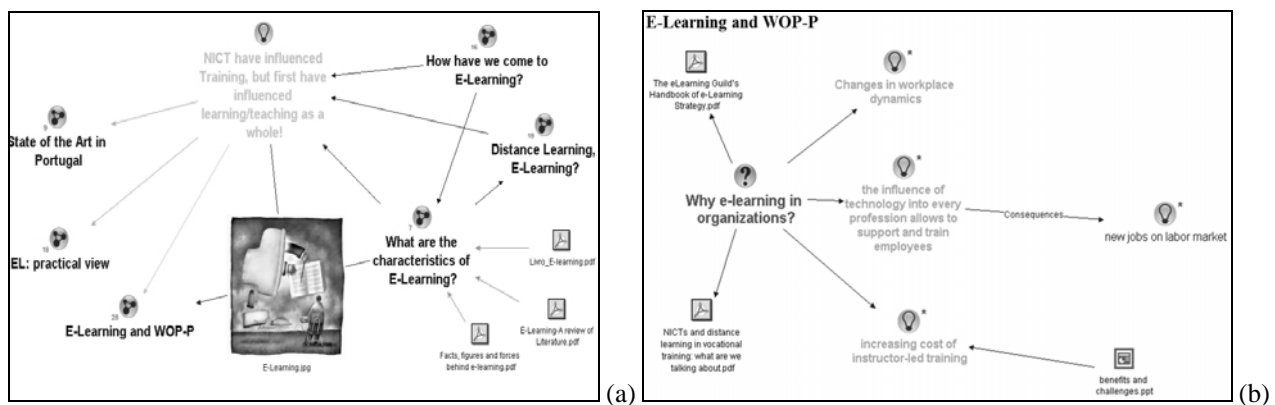
Hy Juliana, also the girls want it so we could see tomorrow afternoon and prepare together it...For you it's ok at 3.00?

Ah...you have already done a good work

**Juliana - Tuesday, 25 March 2008, 20:22**

perfect... see you tomorrow at the cafeteria... i'll take my computer, so we can work on it. bye

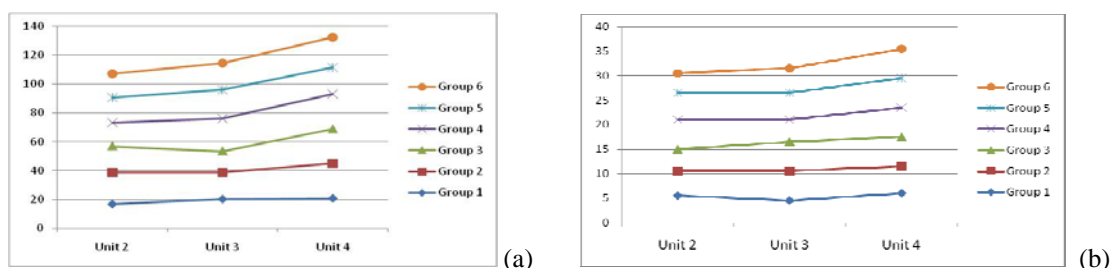
Figure 1 shows two fragments of a map produced by one of the groups. Some questions serve as nodes and help structuring many parts of the map. Compendium allows images to be used as nodes and different icons to represent attached documents (📎, 📄, 📁 etc.), sub-maps (🌐), questions (❓), comments (💬), and many other elements, not represented in figure 1, such as notes and hyperlinks. Different fonts and colours were used in order to emphasize certain ideas. As result, we have a hypermedia-enriched map representing the topic explored by the students.



**Fig. 1** Two parts of a hypermedia map produced by one of the groups. Figure a) shows the first level of the map. By clicking on the icon labelled “E-Learning and WOP-P”, it opens the sub-map show in figure b).

Each group had about one hour to present their map. During the presentations, the teacher made comments and gave feedback both on the topics and on the maps. This, together with the many discussions evoked and the huge amount of information included on the maps, made the intended time for presentation insufficient. Therefore, we agreed to extend the remaining classes for an extra hour, so that all groups could have enough time for their presentations.

Both the maps (Fig.2a) and the presentation (Fig. 2b) scores of all the groups have increased. To certain extent, this was expected, since we adopted a formative evaluation process with frequent feedback to the groups, and through divulgation of partial scores at the end of each unit.



**Fig. 2a,b** The stacked line charts show scores of group maps (a) and group presentations (b) along the course units.

As for the course evaluation, 11 students (46%) answered the form, and many of the non-respondent students justified later that they were overloaded with other tasks from the master program. Concerning the overall methodology adopted in the course, nine students believed that it contributed to enhance learning. About the questorming process,

eight students found that it helped on further investigation of the topics, but some of them expressed doubts about the “right way to do it”. Some student written comments were:

- “If taken to the “next level” (if we don’t ask basic questions...), it can be highly profitable and can lead to many important reflections, ideas and new ways to explore the issues.”
- “I think that the questorming help us to increase our curiosity about some topics! I think, it helped and it will help us to improve our own judgment and our learning methodologies! We have been taught to assimilate the contents in a linear way, and this new methodology - to make questions and to answer them - give us more flexibility to our own learning!”
- “because first I read some articles about the topic, to have an idea of it, and then I started to think in the questions, but most of them were related to the ideas i’ve already read... and I’m not sure if that is the right way to make a good questorming!!!!”

About the process of map creation, nine students believed that the maps generation process contributed to their learning, although one student felt overwhelmed by too many maps. On this some comments were:

- “The fact that I had to read lots of articles about each theme, look for images on the Internet, videos, etc., provoke a better learning about each theme. In fact, at the end of each map, I felt that I was prepared to respond to any question related to the theme, because I read so much about it.”
- “The highest benefits of using the maps had to do with new ways of structuring the information and new ways of “seeing/reading” input information, leading to questioning and need of search for more information to complete the map as a whole.”
- “I think that the maps are a good strategy... but there were too many maps!!! it was a little overwhelming sometimes... I think that for some topics it’s possible to use other methodologies, so we can have different approaches to the themes...”

Concerning the statement “the technologies available for this course (e.g. computers, learning environment, software etc.) helped me to learn”, nine students agreed or strongly agreed. One student commented on the availability of the open source technologies:

- “I agree, especially about the software that we used! This is a very available tool that we can continue to use!”

## 4. Conclusions

Scores point to an improvement of students’ maps and presentations, and reports on students’ satisfaction with different aspects of the course were quite positive. However, results cannot be conclusive. We suggest that further studies with greater number of students answering the evaluation questionnaire should be conducted and rubrics should be validated (such as in [7]), evaluated, and scored independently by other experts. Even in this situation, it would not be possible to use a criterion map to assess map correctness because of the characteristics of the subject domain. What *ought to be* included in a map on ‘e-learning’ or on ‘virtual organizations’ is not totally clear, even for specialists. For the same reason, pre and post-test for assessing students’ knowledge would also lack validity. It also would be interesting to analyse if there is a relation between maps’ mean scores (attributed by independent judges) and indicators such as number and type of nodes, links, and hypermedia documents (similar to the quantitative analysis done by Stoyanov and Kommers [5]).

Nevertheless, we believe that the implementation of the web-based inquiry learning model we have proposed was relatively successful and adequate to the learning setting: tasks proposed were sufficiently stimulating to the majority of the class; the initial training unit helped most students to manage the tools and techniques used during the course; freedom on the construction of hypermedia maps allowed students to explore creatively the subject domain; self-managed collaboration together with group presentations contributed to preserve the uniqueness and value each student and group production. Finally, the open educational resources used as support were of fundamental importance. Not only because they were freely available and easy to use, but also because they also allowed the student to experience in practice some of the concepts they were studying in theory. In addition, following the philosophy of open educational resources, with the authorization of students, the maps produced were made publicly available, making possible for them to be improved and re-used by a broader community<sup>v</sup>.

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<sup>v</sup> See: <http://labspace.open.ac.uk/course/enrol.php?id=3593>

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